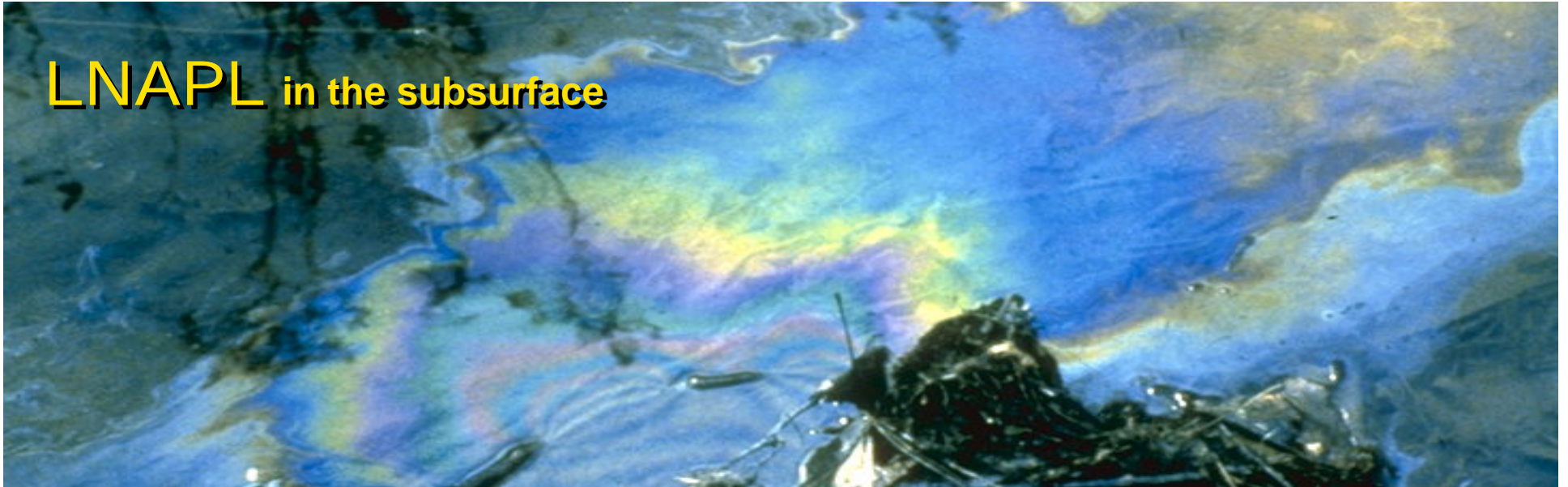


# LNAPL in the subsurface



## Current LNAPL guidance and tools

Randall Charbeneau, P.E.  
Professor of Civil Engineering, University of Texas

&

Mark Adamski, P.G.  
Technical Specialist and Environmental Business Manager, BP America



## Resources to help explain LNAPL behavior

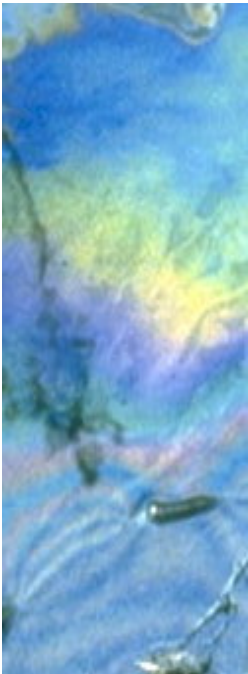


### Completed work

- EPA RTDF – [www.rtdf.org](http://www.rtdf.org)
- ASTM E 2531 – Development of CSM for LNAPL sites
- API LNAPL Resource Center – [www.api.org/LNAPL](http://www.api.org/LNAPL)
- Texas TCEQ – NAPL guidance TRRP 32
- Approaches for evaluation of LNAPL mobility (Golder, 2005) for Science Advisory Board of Contaminated Sites in British Columbia -  
<http://www.sabcs.chem.uvic.ca/LNAPL%20Guidance%2002-15-06%20rev.pdf>

### Work in progress / coming soon

- ITRC LNAPL work group
- Los Angeles Regional Water Quality Control Board / Western States Petroleum Association LNAPL work group



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## EPA RTDF

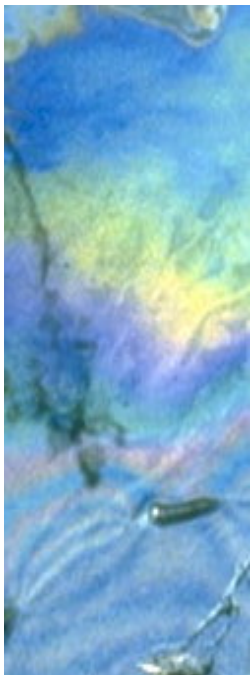
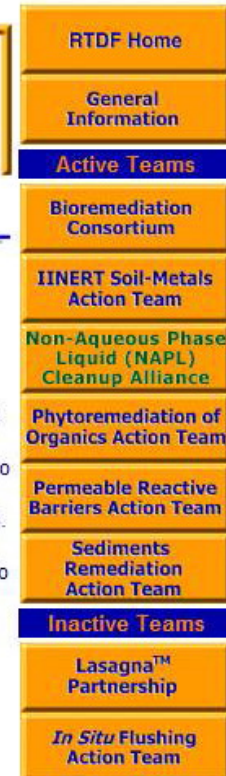


- Source for LNAPL management framework
- Very good online LNAPL Basics training

<http://www.rtdf.org/public/napl/>



The Non-Aqueous Phase Liquid (NAPL) Cleanup Alliance, established in 2001, is one of the six active Action Teams under the Remediation Technologies Development Forum (RTDF). The U.S. Environmental Protection Agency (EPA) created the RTDF in 1992 to foster collaboration between the public and private sectors in developing innovative solutions to mutual hazardous waste problems. The NAPL Cleanup Alliance includes representatives from the petroleum industry, federal and state government, and academia who share an interest in pursuing aggressive technologies for removing large-scale non-aqueous phase liquid (NAPL) contamination.



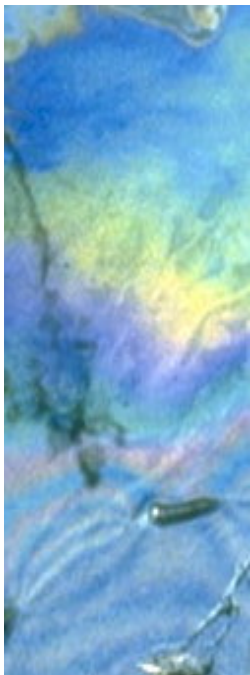
LNAPL in the subsur



## ASTM E 2531-06



- **ASTM E 2531 – Development of CSM for remediation strategies for LNAPL released to the subsurface**
- **Tier process with higher tiers for more difficult sites**
- **Provides framework for developing a CSM**
  - Guide for remediation metrics
  - Remediation strategy should be consistent with site objectives
  - Movement of LNAPL should be measured at a scale pertinent to LNAPL site objectives



LNAPL in the subsurface



Designation: E 2531 – 06

### Standard Guide for Development of Conceptual Site Models and Remediation Strategies for Light Nonaqueous-Phase Liquids Released to the Subsurface<sup>1</sup>

This standard is issued under the fixed designation E 2531; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.



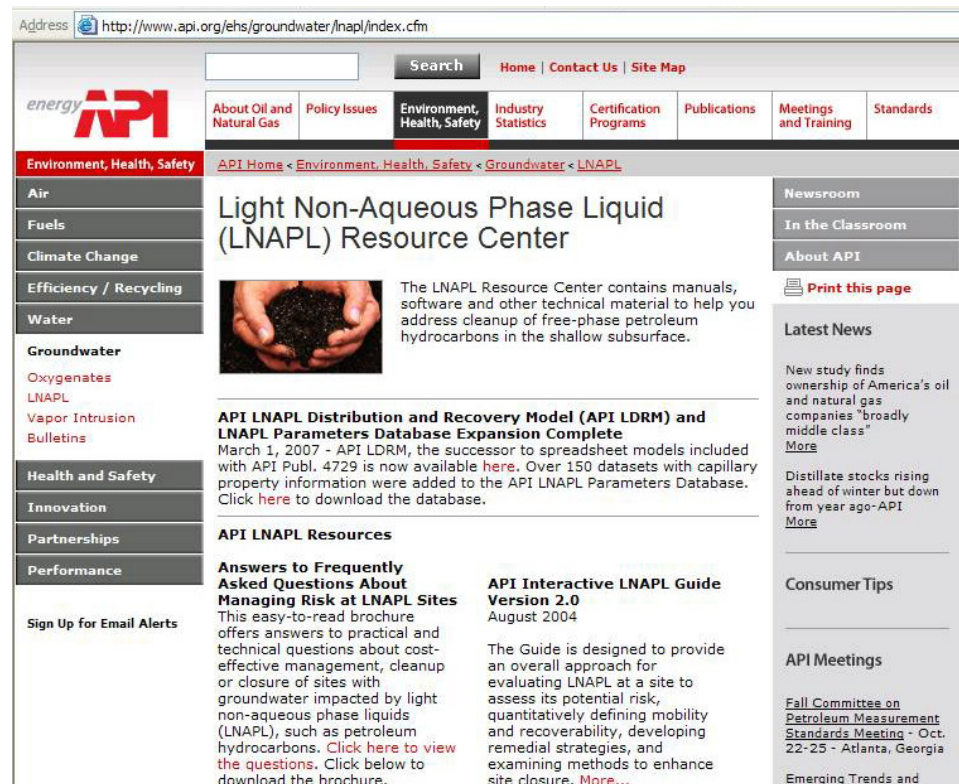


# API LNAPL Resource Center

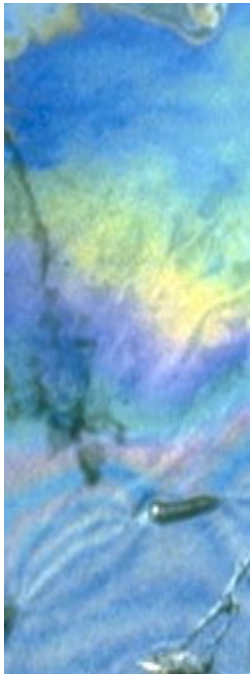


- THE place to start for LNAPL tools and information
- Latest versions of API toolkit, LDRM, LNAPL FAQs, and Database

[www.api.org/LNAPL](http://www.api.org/LNAPL)



The screenshot shows the API LNAPL Resource Center website. The address bar displays <http://www.api.org/ehs/groundwater/lnapl/index.cfm>. The page features the API logo and a navigation menu with links to About Oil and Natural Gas, Policy Issues, Environment, Health, Safety, Industry Statistics, Certification Programs, Publications, Meetings and Training, and Standards. The main content area is titled "Light Non-Aqueous Phase Liquid (LNAPL) Resource Center" and includes a description of the center's purpose, a list of resources, and a section for frequently asked questions. The left sidebar contains a list of topics: Air, Fuels, Climate Change, Efficiency / Recycling, Water, Groundwater, Oxygenates, LNAPL, Vapor Intrusion, Bulletins, Health and Safety, Innovation, Partnerships, and Performance. The right sidebar includes a Newsroom section with links to In the Classroom and About API, a Latest News section with a link to Print this page, and a Consumer Tips section.



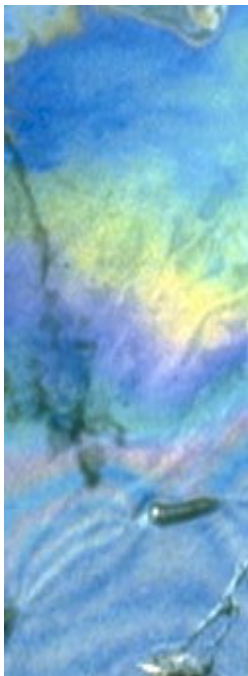
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## Texas TCEQ – TRRP LNAPL guidance





- LNAPL approach should be consistent with over all site strategy
- Allows for plume management zone and in that case the recovery of readily recoverable LNAPL
- Uses  $D_n$  (LNAPL formation specific volume) as endpoint



LNAPL in

Address <http://www.tceq.state.tx.us/remediation/trrp/guidance.html>



**SITE SEARCH:**  
   
**SUBJECT INDEX**  
[> Air](#) [> Water](#) [> Waste](#)  
[> Search TCEQ Data](#)  
[> Agency Organization Map](#)

**TCEQ TEXAS COMMISSION ON ENVIRONMENTAL QUALITY**

**Site Navigation**

- [Rules, Policy & Legislation](#)
- [Permits, Licenses & Registrations](#)
- [Compliance, Enforcement & Cleanups](#)
- [Drinking Water & Water Availability](#)
- [Reporting](#)
- [Environmental Quality](#)
- [Assistance, Education & Participation](#)
- [Pollution Prevention & Recycling](#)
- [Contracts, Funding & Fees](#)

**TRRP Guidance and Forms**

Following are the TRRP guidance documents. **Documents without a link for downloading are not yet available and will be posted as soon as they are published.** We appreciate comments on the usability of the documents and forms. If you have comments, please [e-mail the Technical Support Section](#). We will make improvements to the documents and forms based on these comments.

Use Adobe Acrobat Reader version 4.0 or higher to view these files. (See these web pages for help with [PDF files](#) and downloading [executable \(.exe\) files](#).)

**RELATED LINKS:**  
[Texas Risk Reduction Program](#)

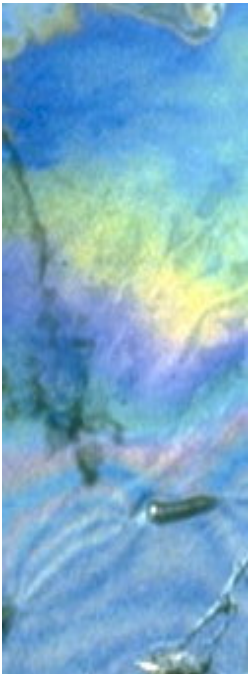
**BACK TO:** [Texas Risk Reduction Program](#)  
**Questions or Comments:**  
[techsup@tceq.state.tx.us](mailto:techsup@tceq.state.tx.us)



British Columbia



- **Approaches for evaluation of LNAPL mobility (Golder, 2005) - Science Advisory Board of Contaminated Sites in British Columbia**
- **Provides good basics discussion of LNAPL and in section 9 it presents a line of evidence approach for evaluation of LNAPL mobility**
- **Lines of Evidence**
  - Primary – is plume behavior – does it appear stable?
  - Recovery analysis – has recovery dropped off
  - Theoretical Estimate of LNAPL mobility – what does transmissivity and gradient tell you?
  - Theoretical Estimate of LNAPL Movement at the plume front – threshold entry pressure
  - Lab tests



LNAPL in the subsurface



## ITRC LNAPL Team Deliverables

White Paper – **“Criteria for Evaluating Innovative / Aggressive Technologies for Application at Large LNAPL-Impacted Sites.”**

Technology Overview Document – **“LNAPL Source Zone Natural Attenuation”**

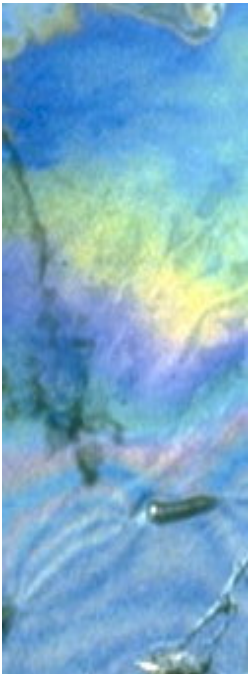
- 1) summarize information on the natural dissolution, volatilization and biodegradation of LNAPL source zones,
- 2) provide approaches to assessing the rate that SZNA is occurring and the sustainability of the process, and
- 3) discuss how to apply this information to determine how SZNA will affect the long-term attainment of groundwater cleanup goals.

Tech-Reg Document – **“Evaluation of the Cost and Effectiveness of Innovative / Aggressive Technology Applications at LNAPL-Impacted Sites.”**

- A technology overview and examination of documented applications of a broad range of LNAPL strategies will be presented.

Classroom and Internet Training

- Classroom and Internet Training Module 1 - “The Basics – Understanding the Behavior of LNAPLs in the Subsurface”.
- Classroom and Internet Training Module 2 - “Applying An Improved LNAPL Understanding and What it Means for the Environment”



LNAPL in the subsurface

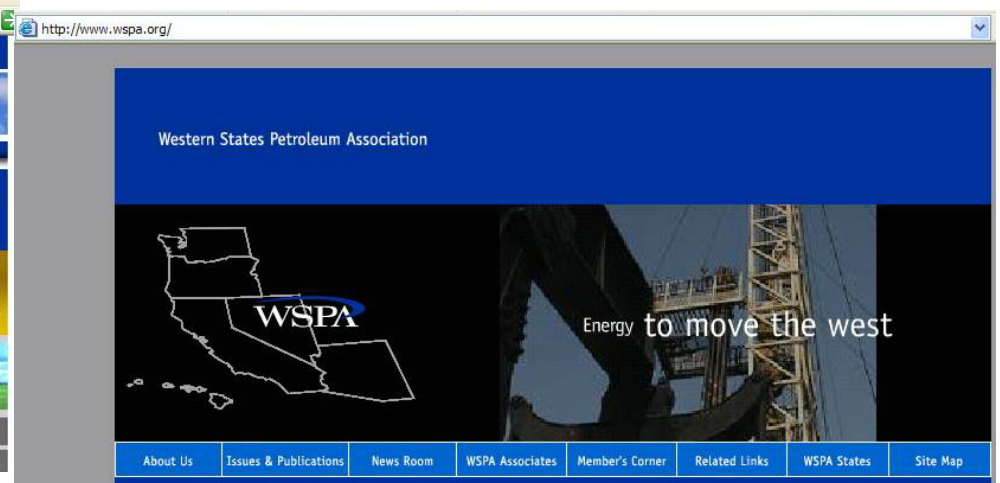
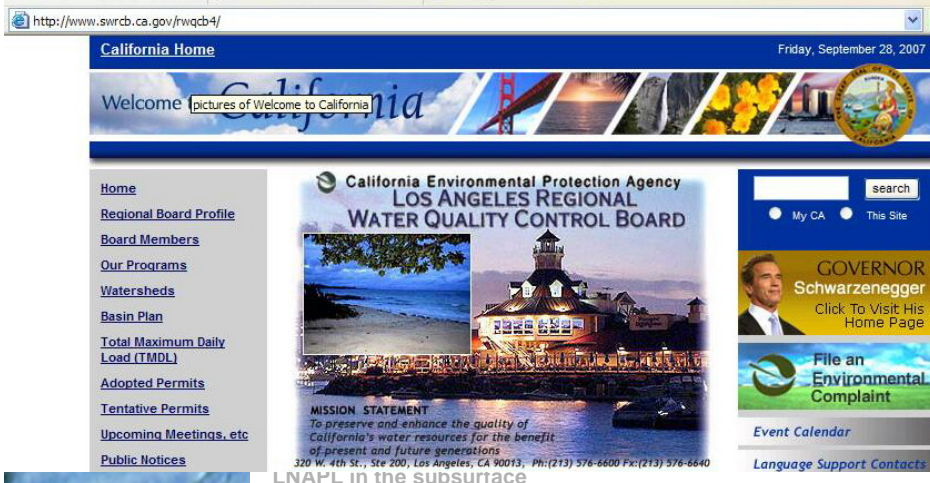




## LA RWQCB / WSPA LNAPL workgroup



- Work group consisting of Water Board / Western States Petroleum Association LNAPL
- Formed in 2007
- Developing a procedure for assessing and remediating LNAPL sites in LA area
- Going to pilot test most promising (innovative) technologies for LNAPL sites in LA area

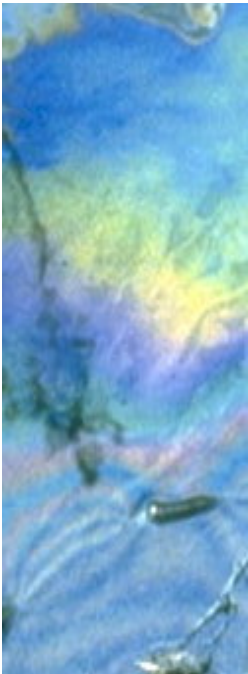




## Key Points



- A lot of tools to help are available at the sites listed above
- Call Mark if you have a quick question or need an LNAPL reference - (281) 366-7435
- Dr. Huntley – right here in San Diego
- Handful of really good LNAPL consultants – be careful in making this choice.



LNAPL in the subsurface



Thank You

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